

WHAT IS CLAIMED IS:

1. A method for altering the growth characteristics of a plant comprising the step of incorporating into the genome of the plant a recombinant DNA molecule comprising a nucleotide sequence encoding 4-coumarate Co-enzyme A ligase such that when the nucleotide sequence is expressed in the plant, the growth of the plant is altered.
2. The method as set forth in claim 1 wherein the DNA molecule comprises a homologous nucleotide sequence.
3. The method as set forth in claim 1 wherein the DNA molecule comprises a heterologous nucleotide sequence.
4. The method as set forth in claim 1 wherein the DNA molecule is incorporated into the genome of the plant by transformation using an Agrobacterium transfer vector.
5. The method as set forth in claim 1 wherein the DNA molecule comprises the nucleotide sequence in antisense orientation.
6. The method as set forth in claim 1 wherein the DNA molecule comprises the nucleotide sequence in sense orientation.
7. The method as set forth in claim 6 wherein the DNA molecule is a cloned cDNA sequence of 4-coumarate Co-enzyme A ligase.
8. The method as set forth in claim 1 wherein the recombinant DNA molecule comprises the promoter sequence of CaMV35S.
9. The method as set forth in claim 1 wherein said altered growth is manifested as an increase in biomass.

10. A plant having its growth characteristic altered through the incorporation into the genome of the plant a recombinant DNA molecule comprising a nucleotide sequence encoding 4-coumarate Co-enzyme A ligase such that when the nucleotide sequence is expressed in the plant, the growth
5 characteristic of the plant is altered.

11. The plant as set forth in claim 10 wherein the DNA molecule comprises the nucleotide sequence in antisense orientation.

10 12. The plant as set forth in claim 10 wherein the DNA molecule comprises the nucleotide sequence in sense orientation.

13. The plant as set forth in claim 10 wherein the DNA is incorporated into the genome of the plant by transformation using an
15 Agrobacterium transfer vector.

14. The plant as set forth in claim 10 wherein the DNA molecule is a cloned cDNA sequence encoding 4-coumarate Co-enzyme A ligase.

20 15. The plant as set forth in claim 10 wherein the DNA molecule comprises the promoter of CaMV35S.

16. The plant as set forth in claim 10 wherein said altered growth is manifested as an increase in plant biomass.

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17. The plant as set forth in claim 10 which is a tree.

18. A method for altering a characteristic of a plant comprising the step of genetically down regulating the enzyme 4-coumarate Co-enzyme A
30 ligase, wherein the characteristic is selected from the group consisting of accelerated growth, reduced lignin content, altered lignin structure, increased disease resistance and increased cellulose content.

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22. The method as set forth in claim 18 wherein the nucleotide
15 sequence is a cloned cDNA sequence encoding 4-coumarate Co-enzyme A
ligase.

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26. The plant of claim 24 wherein the recombinant DNA molecule is incorporated into the genome of the plant by transformation using an *Agrobacterium* transfer vector.

27. The plant of claim 24 wherein the nucleotide sequence is a cloned cDNA sequence of 4-coumarate Co-enzyme A ligase.

28. The plant of claim 24 wherein the recombinant DNA molecule comprises a promoter of CaMV35S.

29. An isolated and purified DNA molecule comprising a DNA segment comprising a transcriptional regulatory region of a plant 4-coumarate Co-enzyme A ligase gene.

30. The isolated and purified DNA molecule of claim 29 in which the DNA segment is from aspen.

31. The isolated and purified DNA molecule of claim 29 wherein the DNA segment directs expression of a linked sequence to the xylem of a plant.

32. The isolated and purified DNA molecule of claim 29 wherein the DNA segment directs expression of a linked sequence to the epidermal tissue of a plant.

33. A method of imparting disease resistance to a plant tissue comprising:

- (a) introducing an expression cassette comprising a recombinant DNA molecule comprising a nucleotide sequence encoding a 4-coumarate Co-enzyme A ligase operably linked to a promoter functional in a plant cell into cells of a plant;
- (b) regenerating said plant cells to provide a transgenic plant; and

- (c) expressing the recombinant DNA molecule in the cells of the transgenic plant in an amount effective to render the plant resistant to disease.

5 34. The method according to claim 33 wherein the disease is caused by a fungus.

10 35. The method according to claim 33 wherein the nucleotide sequence is in the antisense orientation.

10 36. A transgenic plant prepared by the method of claim 33.

37. A transgenic seed of the transgenic plant of claim 33.

15 38. A transgenic plant, which plant is substantially resistant to disease, comprising:

- (a) a native 4-coumarate Co-enzyme A ligase gene, and
(b) a recombinant DNA molecule comprising a nucleotide sequence encoding 4-coumarate Co-enzyme A ligase operably linked to a promoter functional in a plant wherein the recombinant DNA molecule is expressed in an amount effective to confer resistance to the transgenic plant.
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25 39. A method for altering the lignin content in a plant comprising:

- (a) introducing an expression cassette comprising a recombinant DNA molecule encoding a 4-coumarate Co-enzyme A ligase operably linked to a promoter functional in a plant cell into the cells of a plant;
(b) regenerating said plant cells to provide a transgenic plant; and
(c) expressing the recombinant DNA molecule in the cells of the transgenic plant in an amount effective to alter the lignin content in the plant cells.
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40. A transgenic plant having an altered lignin content in the plant cells comprising: a recombinant DNA molecule comprising a nucleotide sequence encoding a plant 4-coumarate Co-enzyme A ligase operably linked to a promoter so that the recombinant DNA molecule is expressed in an amount effective to alter the lignin content of the plant.

41. A method for altering the cellulose content in a plant comprising:

(a) introducing an expression cassette comprising a recombinant DNA molecule comprising a nucleotide sequence encoding a 4-coumarate Co-enzyme A ligase operably linked to a promoter functional in a plant cell into the cells of a plant;

(b) regenerating said plant cells to provide a transgenic plant; and

(c) expressing the recombinant DNA molecule in the cells of the transgenic plant in an amount effective to alter the cellulose content in the plant.

42. A transgenic plant having an altered cellulose content in the plant cells comprising: a recombinant DNA molecule comprising a recombinant DNA molecule sequence encoding a plant 4-coumarate Co-enzyme A ligase operably linked to a promoter so that the recombinant DNA molecule is expressed in an amount effective to alter the cellulose content of the plants.

43. A method for altering the lignin structure in a plant comprising:

(a) introducing an expression cassette comprising a recombinant DNA molecule comprising a recombinant DNA nucleotide sequence encoding a 4-coumarate Co-enzyme A ligase operably linked to a promoter functional in a plant cell into the cells of a plant;

(b) regenerating said plant cells to provide a transgenic plant; and

(c) expressing the recombinant DNA molecule in the cells of the transgenic plant in an amount effective to alter the lignin structure in the plants.

44. A transformed plant having an altered lignin structure comprising: a recombinant DNA molecule comprising a nucleotide sequence encoding a plant 4-coumarate Co-enzyme A ligase operably linked to a promoter so that the

recombinant DNA molecule is expressed in an amount effective to alter the lignin structure of the plant.

5 ^{sub}cs 45. An expression cassette comprising a transcriptional control region of a 4-coumarate Co-enzyme A ligase gene operably linked to a DNA segment comprising an open reading frame.

10 46. A method of expressing a DNA segment in the xylem of a plant, comprising:
(a) introducing an expression cassette comprising a transcriptional control region of a 4-coumarate Co-enzyme A ligase gene operably linked to a DNA segment into cells of a plant;
(b) regenerating the plant cells to provide a transgenic plant; and
(c) expressing the DNA segment in the xylem of a plant.

15 47. A method of expressing a DNA segment in the epidermal tissue of a plant, comprising:
(a) introducing an expression cassette comprising a transcriptional control region of a 4-coumarate Co-enzyme A ligase gene purple
20 operably linked to a DNA segment into cells of a plant;
(b) regenerating the plant cells to provide a transgenic plant; and
(c) expressing the DNA segment in the epidermal tissue of a plant.

25 48. The method of claim 46 wherein the transgenic plant has altered lignin content, lignin structure, cellulose content or wood quality relative to the corresponding non-transgenic plant.

30 49. The plant of claim 38 which has altered levels of phenylpropanoids or other secondary metabolites relative to the corresponding non-transgenic plant.

50. The method of claim 1 wherein the plant has enhanced root growth.

51. The plant of claim 10 wherein the plant has enhanced root growth.
52. The method of claim 1 wherein the plant has enhanced root development.
53. The plant of claim 10 wherein the plant has enhanced root development.

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